Space Weather Technical Forecast

Issued on Tuesday, 24 May 2022 at 13:28 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of R1-R2 Radio Blackouts through the forecast period. Minor geomagnetic storms possible on 26th or 27th.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Low through the last 24 hours with only C-class flare activity, mainly from AR3017 (Eai/βγ). The other significant region in the northwest quadrant, AR3014 (Ekc/βγδ) has produced limited activity. The remaining seven regions are all small and currently benign. A CME which appeared to emanate from AR3017 on 23rd May has been analysed and appears to be too slow to be Earth-directed, based on limited imagery. No Earth-directed CMEs have been observed on available imagery.

Solar Wind / Geomagnetic Activity: The solar wind at L1 has followed a steady decline through the last 24 hours from around 550km/s to close to 400km/s as the high speed stream from coronal hole 82 eases. Density has been mainly below average. Total magnetic field strength was weak, with the north-south component, Bz, only varying weakly. Phi angle started negative (towards the Sun) but quickly rotated into a positive direction. Total geomagnetic activity was Quiet throughout.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at background levels through the last 24 hours. The high energy electron flux (greater than 2 MeV) rose to mainly moderate levels, only briefly exceeding the high threshold at 1051pfu at 23/1325UTC. Corresponding electron fluence remained well below the Active threshold (1e8 integrated pfu) with a rising then level trend to reach 4.6e7 integrated pfu at 24/0000UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is expected to be mainly Low, but with a chance of Moderate activity and a very slight chance of High activity. This is due to two large, complex regions in the western hemisphere and the potential for new complex regions to rotate across from the east.
Solar Wind / Geomagnetic Activity: No CMEs are currently expected with a CME from an eruption on 23rd May considered to not be Earth-directed. Solar winds are expected to be close to or at ambient levels through 24th and 25th May. Two coronal hole high speed stream connections on 26th and perhaps early on 27th May could elevate winds to between 500-550km/s. Geomagnetic activity is forecast to be mainly Quiet for 24th and 25th May. Active intervals are then possible during 26th May, with a risk of G1/Minor Storms later on 26th and perhaps early on 27th May.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to be at background levels during this period, with a slight chance of reach S1 levels. High energy electron flux (greater than 2MeV) is expected to be at generally moderate levels through 24th and 25th May, perhaps falling to background levels on 27th May due to geomagnetic enhancements. Electron fluence is forecast to follow a declining trend for the next 3 days, with a slight rise then possible in 28th May.

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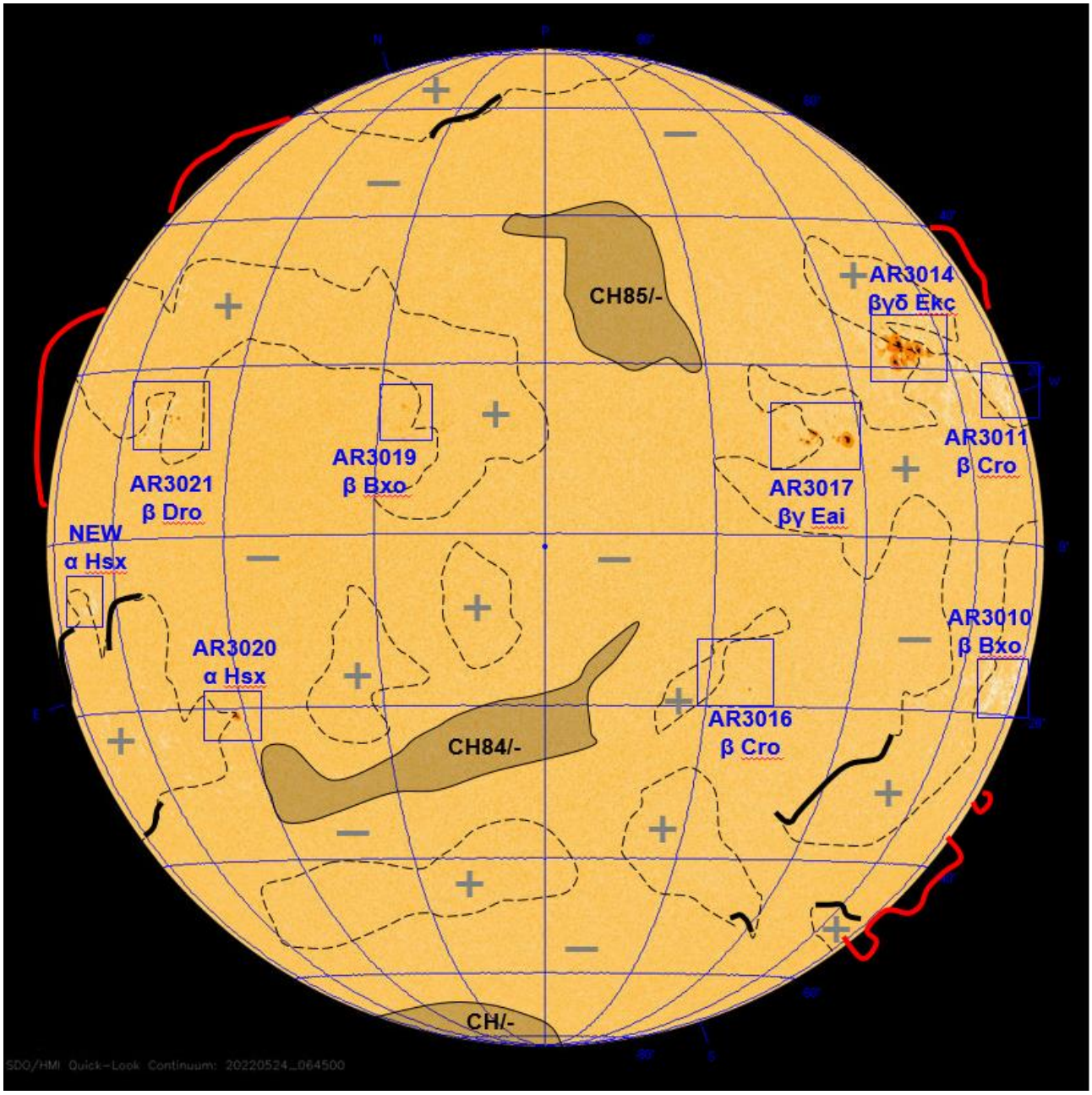
Figure 1. Solar Analysis Valid 24/0800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

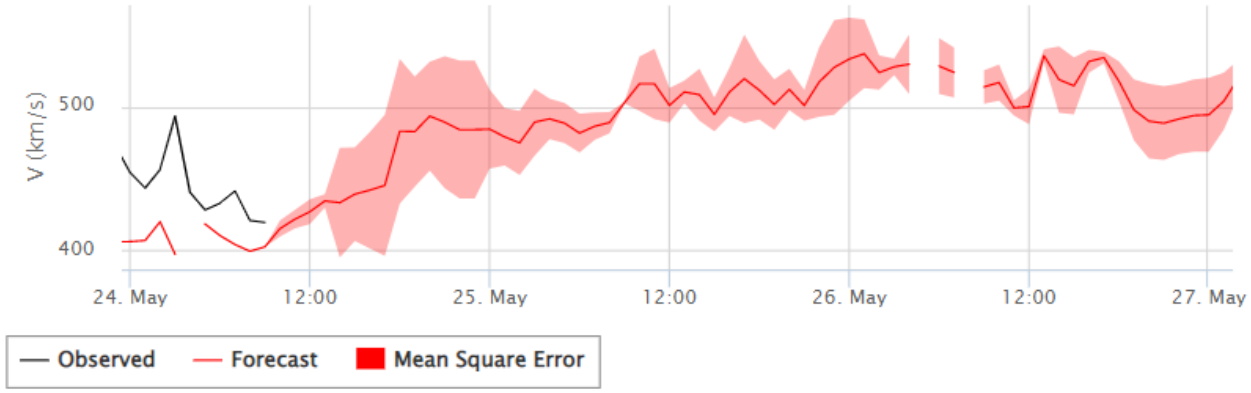
There are no CME currently forecast, although there was a possible filament lift-off from the northwest yesterday which appears to be too slow to affect the Earth.

Solar wind speeds are expected to continue to decline through the remainder of day 1 (24th May). Ambient speeds are then expected on 25th May, with a possible connection to the high speed stream from coronal hole 85 on 26th May. This coronal hole is in the northern hemisphere so there is low confidence of a relatively weak high speed stream from this feature. A connection to the high speed stream from coronal hole 84 is then expected either later on 26th or during 27th May. This is a persistent feature which produced winds of 500-550km/s on the last rotation, with similar speeds forecast on this occasion. This is based both on the visual strength of the feature and recent observations from STEREO A.

Geomagnetic activity is expected to start Quiet, with a risk of Active intervals due to any connection with coronal hole 85. A stronger connection is possible for coronal hole 84 with a slight chance of G1/Minor Storms on 27th May.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	10	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC solar wind persistence model SWPM, showing the potential increasing in solar wind speeds forecast for the next few days, based on the previous solar rotation.



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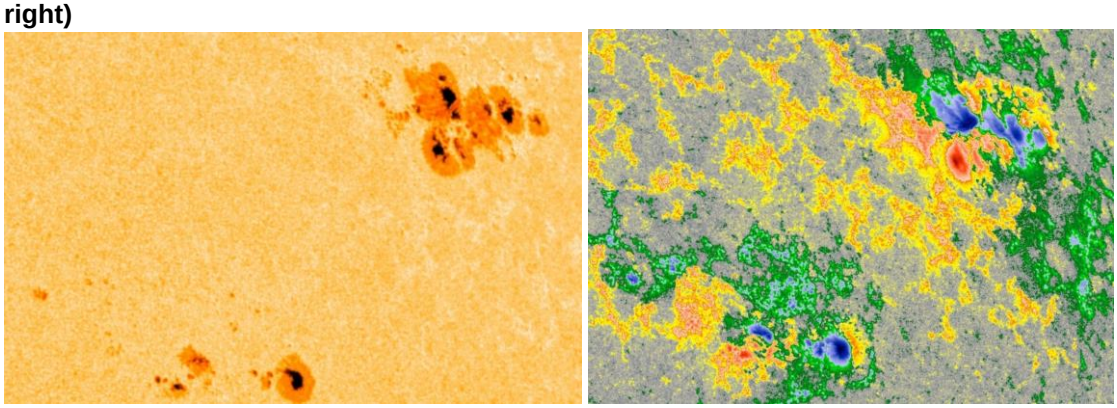
Radio Blackouts - X-Ray Flares:
AR3014 and AR3017 are the most significant regions on the visible disc, with AR3014 the most active over the last 24 hours, albeit with only C-class flare activity. These regions continue to present the greatest risk, but with around half the chance of an M-class flare when compared to historically similar regions.

There are seven further regions visible, with all of these simple unipolar or bipolar regions presenting very low flare risks. Bright flux on STEREO A EUVI imagery suggests that further significant sunspot regions could rotate across the eastern limb through the next four days. Solar activity is expected to be mainly Low, but with a chance of Moderate activity and a very slight chance of High activity.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: HMI intensitygram and magnetogram imagery for AR3017 (bottom-left) and AR3014 (top-right)



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is at background levels and is most likely to remain so through the period.

There is a slight increase in the risk of solar radiation storms through the next four days as regions AR3014 and AR3017 rotate towards the western limb, with this being the prime region for Earth-directed storms.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) has declined during the last 24 hours, with the latest peak lower than for the previous day. This trend is expected to continue for the next two days, with a more significant drop to background then likely on day 3 (26th May) due to geomagnetic effects of a coronal hole high speed stream connection. A rising trend is possible from 28th, but this is dependent on the extent to which the high speed stream distorts the radiation belts.

Electron fluence is now likely to have peaked for the period, with a declining trend through to 26th May. A slightly rising trend is possible towards the end of the period, but the Active (1e8 integrated pfu) threshold is unlikely to be breached.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	10	10	5	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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Figure 4: GOES 16 electron flux

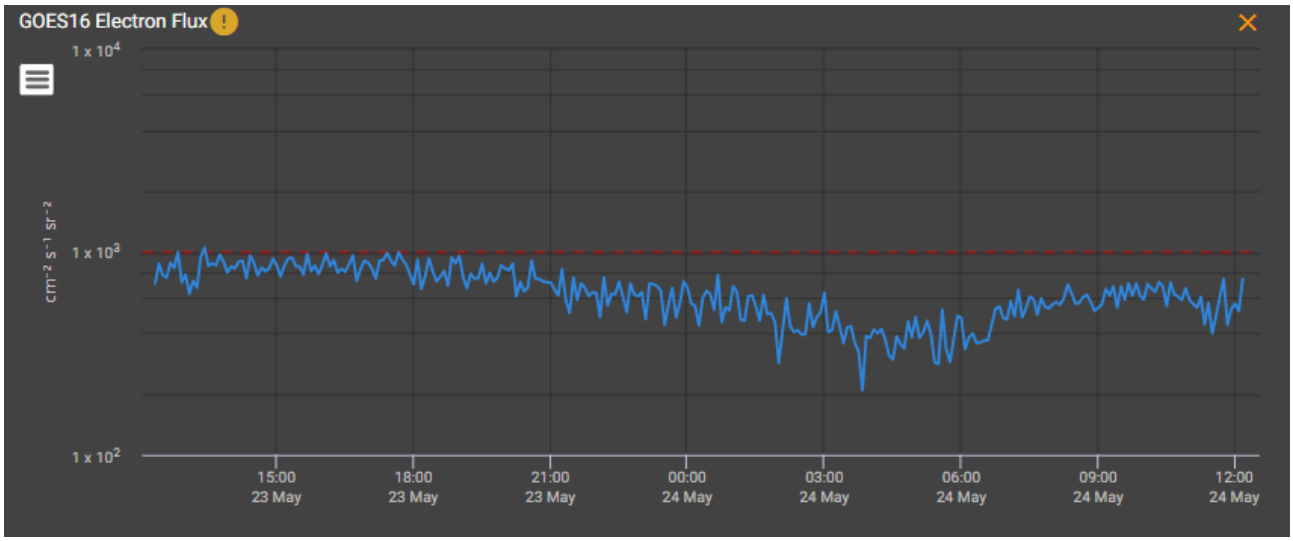
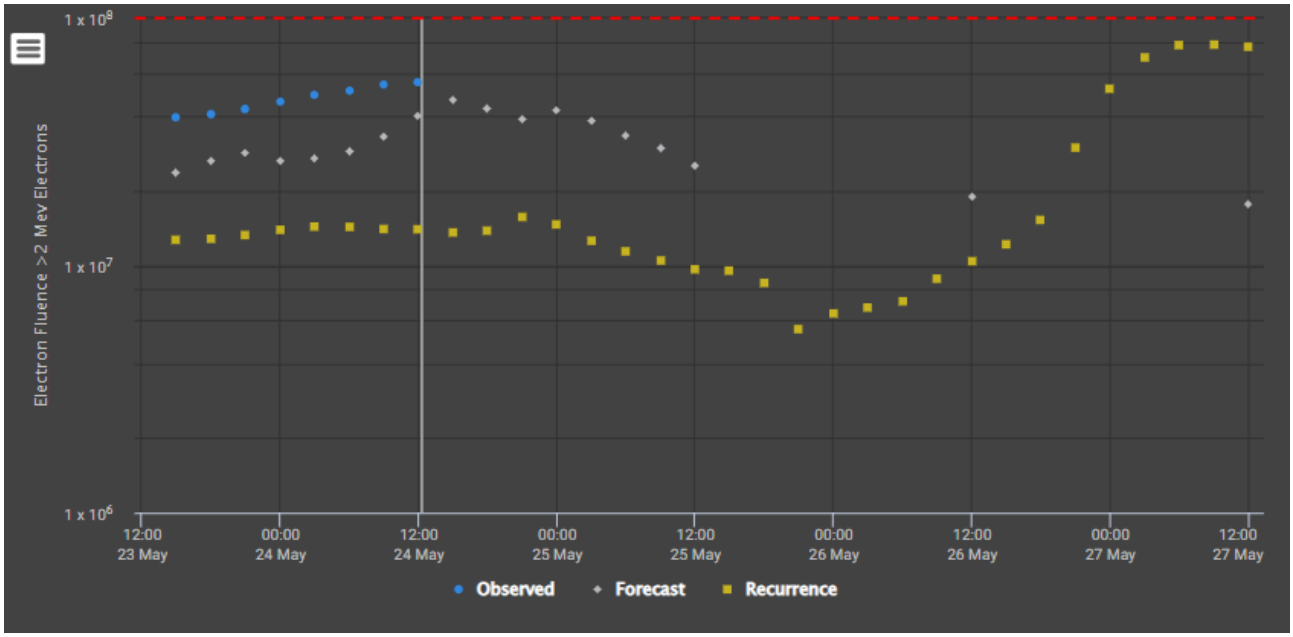


Figure 5: MOSWOC REFM model



NOTE: Our REFM model has been upgraded and has changed in appearance. The two main changes are the option to include a recurrence graph, which superimposes observations from the last solar rotation onto the current solar rotation (each plot is the observation from T-minus 28 days). Recurrence is used as a guide to what can be expected in the coming days assuming no difference in solar features, and has low accuracy in certain situations but good accuracy in others (such as recurring coronal holes). The other change is the cadence of REFM forecast fluence data has been reduced past day 1 to only one value per day. The cadence remains 3-hourly for the first 24 hours.

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